REMARKS

Claims 1, 28 and 30-35 remain pending. For reasons stated below, Applicant respectfully submits that the claims of the present application are patentable over the prior art of record and that the present application is in condition for allowance.

I. Claim Rejections - 35 USC §103(a)

A. In the FINAL Office Action dated October 19, 2010, claims 1, 28 and 32-34 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.

In response to the above rejection, Applicant submits herewith the Sworn Declaration of Yuichiro Shindo under 37 CFR §1.132. Mr. Shindo is the sole inventor of the present application and the sole inventor of the cited prior art reference.

For reasons set out in the Sworn Declaration, Applicant respectfully submits that:

(a) the reduced amounts of Zr content in the Hf material required by the claims of the present application cannot be achieved using the methods disclosed in Applicant's earlier application published as U.S. Patent Application Publication No. 2003/0062261 A1;

(b) Applicant was unaware of a method that would have been known at the time the present invention was made that could provide the reduced amounts of Zr content in Hf material as required by the claims of the present application;

(c) the present invention enabled the production of a gate-insulation film having stable permittivity that was not achievable prior to the present invention and, as a result, commercial success was achieved via the mass production of semiconductor devices; and

(d) at the time the present invention was made, one of ordinary skill in the art had no reason to reduce Zr in a Hf material beyond that taught by the earlier application published as

U.S. Patent Application Publication No. 2003/0062261 A1 because conventional wisdom was that Zr mixed in high purity Hf does not aggravate the properties of semiconductors as expressly stated in U.S. Patent Application Publication No. 2003/0062261 A1.

Thus, for the reasons and facts discussed in the Sworn Declaration, Applicant respectfully submits that the claims of the present application are unobvious and patentable over the teachings of U.S. Patent Application Publication No. 2003/0062261 A1. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection of claims 1, 28 and 32-34.

B. In the FINAL Office Action dated October 19, 2010, claims 30, 31 and 35 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo in view of U.S. Patent Application Publication No. 2003/0052000 A1 of Segal et al.

Applicant respectfully submits that claims 30, 31 and 35 are patentable and unobvious over Shindo '261 in view of Segal et al. for the same reasons discussed above with respect to claims 1, 28 and 32-34 being patentable and unobvious over Shindo '261.

In addition, Segal et al. teach that target material must be subject to "deformation" before the material is molded into a target shape. (For instance, see Paragraph No. 0013 of the Segal et al. reference.) The deformation required by Segal et al. is so-called "high strain" processing technology or "strong" plastic deformation. Segal et al. teach that an integrated strain level corresponding to at least $\varepsilon = 4$ is generated and describe ECAE as a specific processing method. (For instance, see Paragraph Nos. 0041 and 0047-0052 of the Segal et al. reference.)

Applicant respectfully submits that Segal et al. teach-away from the use of conventional thermal/mechanical processing technologies such as forging, rolling and annealing. For instance, in Paragraph No. 0044, Segal et al. teach that:

> "**[0044]** High strain techniques, such as those listed and others, are suitable for forming a microstructure according to the various aspects of the invention described above. ***Traditional thermo-mechanical processing techniques, such as forging, rolling, and annealing may not deliver uniform enough deformation*** to eliminate large grains in a material without the help of alloying additions and/or dopants. Such traditional processes typically produce a significant number of grains with an area of more than 10 times or much more than 10 times the area of a mean grain size. By contrast, some of the listed methods of the present aspect of the invention impart a high degree of strain in a very uniform manner and/or ultra high strain rates in rapid thermal treatments. The desired microstructural control may also be achieved in materials alloyed with additions that control grain stability and growth that are processed with a high degree of strain.

Accordingly, one of ordinary skill in the art following the teachings of Segal et al. would not use traditional thermo-mechanical processing techniques, such as forging, rolling and annealing the target material disclosed by Shindo '261 (which does not include the use of alloying additions and/or dopants) or the high purity hafnium target material required by the claims of the present application.

"Teaching away" is the antithesis of the art suggesting that the person of ordinary skill in the art go in the claimed direction. Essentially, "teaching away" is a per se demonstration of lack of obviousness. In re Fine, 873 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Accordingly, Applicant respectfully submits that the structure of the target of Shino '261 having been processed according to the teachings of Segal et al. would not provide a sputtering target body having a forged and rolled microstructure having been subject to forging and rolling processing as required by the claims of the present application. In addition, if mere forging and rolling is used, Segal et al. teaches and directs one of ordinary skill in the art to add alloying elements and dopants which is clearly opposite of the teachings of the present invention which require a high purity hafnium target material without alloying elements and dopants.

Thus, for the reasons and facts discussed in the Sworn Declaration and for the additional arguments provided above, Applicant respectfully submits that the claims of the present application are unobvious and patentable over the teachings of U.S. Patent Application Publication No. 2003/0062261 A1 in view of the teachings of U.S. Patent Application Publication No. 2003/0052000 A1. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection of claims 30, 31 and 35.

C. *In the FINAL Office Action dated October 19, 2010, claims 1, 28 and 32-34 are rejected under 35 USC §103(a) as being obvious over the publication in the ASM Handbook of Murray titled "Preparation and Characterization of Pure Metals".*

In response to the above rejection, Applicant submits herewith the Sworn Declaration of Yuichiro Shindo under 37 CFR §1.132. For reasons set out in the Sworn Declaration, Applicant respectfully submits that:

(a) the reduced amounts of Zr content in the Hf material required by the claims of the present application cannot be achieved using the iodide process disclosed by the cited publication of Murray in the ASM Handbook titled "Preparation and Characterization of Pure Metals";

(b) Applicant was unaware of a method that would have been known at the time the present invention was made that could provide the reduced amounts of Zr content in Hf material as required by the claims of the present application;

(c) the present invention enabled the production of a gate-insulation film having stable permittivity that was not achievable prior to the present invention and, as a result, commercial success was achieved via the mass production of semiconductor devices; and

(d) at the time the present invention was made, one of ordinary skill in the art had no reason to reduce Zr in a Hf material beyond that taught by the earlier application published as U.S. Patent Application Publication No. 2003/0062261 A1 because conventional wisdom was that Zr mixed in high purity Hf does not aggravate the properties of semiconductors as expressly stated in U.S. Patent Application Publication No. 2003/0062261 A1.

Murray, page 1094, provides the following disclosure:

> "In purification by chemical vapor deposition (CVD), the starting material is reacted to form a gaseous compound, and that compound is subsequently decomposed in the vapor state. The metal vapor then is condensed to form a solid higher in purity than the starting material.
>
> One of the more popular of the chemical vapor deposition processes is the iodide process, which has been used extensively to purify titanium, zirconium, and chromium (Ref 5). For each of these metals, the starting charge of metal is reacted to form a volatile metal iodide compound, which in turn is thermally decomposed to liberate iodine vapor. The pure metal is allowed to condense onto a suitable heated substrate (glass tubes and wires of the base metal have been used), while the iodine returns to the metal charge to form more iodide compound. ***Hence, the iodine acts as a carrier of the metal from the charge to the substrate.***
>
> In the process, ***some impurities are almost always carried over*** to the vapor phase along with the metal being purified. ... ***iron is carried over*** with these metals to a significant extent. "

Murray clearly teaches that "some" impurity metals (plural) are carried over in the CVD method since some impurity metals are similar in terms of the reactivity with the iodine as that of the metals to be purified. For example, Murray highlights a "low-iron starting metal" because Murray readily admits that a significant amount of Fe will be carried over with the metals being purified regardless of temperature and other conditions.

Thus, it is clear to one of ordinary skill in the art that the "iodide process" referred to by Murray is a method of separation ***relying on the difference of chemical behavior between the metal being refined and impurities***. It should be clearly understood that it is extremely difficult to separate Zr from Hf because these elements have such ***similar*** chemical and physical

properties. Thus, the iodide process disclosed by Murray is ineffective at reducing Zr content in an Hf material even if temperature or other conditions are controlled and certainly cannot be used to reduce Zr content to 1000wtppm, 200wtppm, or less. Of course, the reduction of Fe from the raw material would also be unsuccessful. For example, in the Shindo '261 reference, the starting raw material has 500ppm and 300ppm of Fe content. This could not be reduced to the required 10wtppm or less as recited in the claims of the present application.

Further, it should be accepted by the Examiner that Murray only vaguely references a 5N purity and that there is no direct link to this being possible with Hf when specifically considering Zr and Fe among the impurities. For example, Murray clearly states that "some impurities are almost always carried over with the vapor phase along with the metal being purified" and that by controlling temperature, "many metallic impurities, will not be carried over". Here, Murray admits that not "all" metallic impurities can be prevented from being carried over by the iodine to the substrate even if temperature is controlled. "Ref. 5" disclosed by Murray discloses the purity of Hf achievable with the iodide process is 98.92% and 99.22% and also fails to disclose Zr content. Hf and Zr have similar chemical properties and this will render the iodide process useless in separating Zr from Hf.

Still further, Murray discloses a purity of zirconium ("plus hafnium") of 99.98%. It should be understood that the content of Hf in high purity Zr is typically ignored and not included with respect to the purity determination of Zr (as expressly taught by Murray) and that the content of Zr in high purity Hf is typically ignored and not included with respect to the purity determination of Hf. Thus, even if it were possible to achieve a purity of Hf of 5N (99.999%) via the iodide process, this purity determination would be without consideration as to Zr content (i.e. Hf "plus Zr"). This is standard in the industry as evidenced by Murray.

Thus, for the reasons and facts discussed in the Sworn Declaration and for the arguments submitted above, Applicant respectfully submits that the claims of the present application are unobvious and patentable over the teachings of the Murray publication. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection of claims 1, 28 and 32-34.

D. In the FINAL Office Action dated October 19, 2010, claims 30, 31 and 35 are rejected under 35 USC §103(a) as being obvious over the publication in the ASM Handbook of Murray titled "Preparation and Characterization of Pure Metals" in view of U.S. Patent Application Publication No. 2003/0052000 A1 of Segal et al.

Applicant respectfully submits that claims 30, 31 and 35 are patentable and unobvious over Murray in view of Segal et al. for the same reasons discussed above with respect to claims 1, 28 and 32-34 being patentable and unobvious over Murray.

In addition, Segal et al. teach that target material must be subject to "deformation" before the material is molded into a target shape. (For instance, see Paragraph No. 0013 of the Segal et al. reference.) The deformation specifically required by Segal et al. is so-called "high strain" processing technology or "strong" plastic deformation. Segal et al. teach that an integrated strain level corresponding to at least $\varepsilon = 4$ must be generated and describe ECAE as a specific processing method. (For instance, see Paragraph Nos. 0041 and 0047-0052 of the Segal et al. reference.)

Applicant respectfully submits that Segal et al. teach-away from the use of conventional thermal/mechanical processing technologies such as forging, rolling and annealing. For instance, in Paragraph No. 0044, Segal et al. teach that:

> "**[0044]** High strain techniques, such as those listed and others, are suitable for forming a microstructure according to the various aspects of the invention described above. ***Traditional thermo-mechanical processing techniques, such as forging, rolling, and annealing may not deliver uniform enough deformation*** to eliminate large grains in a material without the help of alloying additions and/or dopants. Such traditional processes typically produce a significant number of grains with an area of more than 10 times or much more than 10 times the area of a mean grain size. By contrast, some of the listed methods of the present aspect of the invention impart a high degree of strain in a very uniform manner and/or ultra high strain rates in rapid thermal treatments. The desired microstructural control may also be achieved in materials alloyed with additions that control grain stability and growth that are processed with a high degree of strain.

Accordingly, one of ordinary skill in the art following the teachings of Segal et al. would not use traditional thermo-mechanical processing techniques, such as forging, rolling and annealing the material disclosed by Murray (which does not include the use of alloying additions and/or dopants) or the high purity hafnium target material required by the claims of the present application.

"Teaching away" is the antithesis of the art suggesting that the person of ordinary skill in the art go in the claimed direction. Essentially, "teaching away" is a per se demonstration of lack of obviousness. In re Fine, 873 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988). Accordingly, Applicant respectfully submits that the structure of a target of the material of Murray having been processed according to the teachings of Segal et al. would not provide a sputtering target body having a forged and rolled microstructure having been subject to forging and rolling processing as required by the claims of the present application. In addition, if mere forging and rolling is used, Segal et al. teach and direct one of ordinary skill in the art to add alloying elements and dopants which is clearly opposite of the teachings of the present invention which require a high purity hafnium target material without alloying elements and dopants.

Thus, for the reasons and facts discussed in the Sworn Declaration and for the additional arguments provided above, Applicant respectfully submits that the claims of the present application are unobvious and patentable over the teachings of Murray in view of the teachings of U.S. Patent Application Publication No. 2003/0052000 A1. Accordingly, Applicant respectfully requests reconsideration and removal of the rejection of claims 30, 31 and 35.

II. Conclusion

In view of the above remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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